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Applicant(s): LG Electronics Inc.

COMMISIONER

[ABSTRACT OF THE DISCLOSURE]

[ABSTRACT]

Disclosed is a shadow mask for fabricating an organic electroluminescent (EL) device, having an organic luminescence layer formed at a crossing region of a first and second electrode lines, the shadow mask includes: a first substrate having a plurality of first apertures which are for transiting an electron beam, a second substrate overlapped on one side of the first substrate, the side of which the electron beam is radiated, having a predetermined distance therebetween, wherein the second substrate and the first substrate are overlapped with each other in a shape of stairs.

[TYPICAL DRAWING]

FIG. 8

[INDEX WORDS]

Shadow mask, organic EL, electro-forming

[SPECIFICATION]

[TITLE OF THE INVENTION]

SHADOW MASK FOR FABRICATING ORGANIC EL DEVICE AND FABRICATING METHOD THEREFOR

[BRIEF DESCRIPTION OF THE DRAWINGS]

FIG. 1 is a plan and sectional view, each showing a related art full color organic EL display, respectively;

FIGS. 2A to 2D illustrate sectional views of a related art fabrication process of a full color organic EL display;

FIG. 3 illustrates a plan and sectional view, each showing a related art shadow mask, respectively;

FIGS. 4A to 4C illustrate related art shadow masks fabricated by wet-etching, respectively;

FIGS. 5A and 5B illustrate deposition of a material with a shadow mask fabricated by wet-etching;

FIGS. 6A and 6B illustrate related art shadow masks each fabricated by electro-forming, respectively;

FIGS. 7A and 7B illustrate deposition of a material with a shadow mask fabricated by electro-forming;

FIG. 8 illustrates a plan view and a section each showing a shadow mask in accordance with a preferred embodiment of the present invention, respectively;

FIGS. 9A to 10B illustrate shadow masks in accordance with preferred embodiments of the present invention; and

FIGS. 11A and 11B illustrate deposition of a material using a shadow mask of the present invention.

Reference numerals of the essential parts in the drawings

10: substrate 20: first electrode (cathode)

30: second electrode (anode)

40: organic electroluminescence

50: shadow mask 51, 51a and 51b: projected part

52: aperture 60: buffer layer

70: barrier 80: red light emitting layer

90: green light emitting layer

100: blue light emitting layer

110: source part

[DETAILED DESCRIPTION OF THE INVENTION]

[OBJECT OF THE INVENTION]

[FIELD OF THE INVENTION AND DISCUSSION OF THE RELATED ART]

The present invention is related to an organic electroluminescent (EL) device, and more particularly, to a shadow mask for fabricating an organic EL device with a high reliability, which has a relatively high precision and does not bear any shadow phenomenon.

The organic electroluminescent device emits light in a manner that electric charges are injected in an organic layer formed between an anode and a cathode so as to form a pair of electron and hole to generate an exciton and an excited state of the exciton falls to a ground state so as

to emit light.

The organic electroluminescent device is not only formed on a flexible transparent substrate such as a plastic but also operated at a lower voltage (less than 10V) compared to a plasma display panel or an inorganic electroluminescent display. Also, the organic electroluminescent device has advantages in that power consumption is reduced and various colors are available.

FIG. 1 is a plan and sectional view, each showing a related art full color organic EL display, respectively.

Referring to FIG. 1, a first electrode (cathode) 20 is patterned in stripes on a transparent substrate 10 using a chemical etching, and thereafter an organic EL layer is deposited in vacuum.

Consecutively, a second electrode (anode) is patterned on the organic EL layer in a perpendicular direction to the first electrode using a shadow mask.

FIGS. 2A to 2D illustrate sectional views of a related art fabrication process of a full color organic EL display.

Referring to FIG. 2A, after a transparent indium tin oxide (ITO) film (first electrode) is formed on the transparent substrate in stripes, in order to form the second electrode in stripes in perpendicular direction to the transparent substrate, a plurality of barriers can be

formed in a form of stripes separated one another with a predetermined distance.

In this instance, before forming the barrier, a buffer layer is formed.

Subsequently, a red light emitting layer is deposited in each region of the barrier using the shadow mask having a plurality of via holes.

Referring to FIG. 2B, the shadow mask is moved a bit to form a green light emitting layer. The blue light emitting layer is formed in the above manner as shown in FIG. 2C.

Referring to FIG. 2D, the luminescent substance is formed in red, blue and green pixel areas, and thereafter a shadow mask is placed on the form the second electrode (anode) on the entire space including the pixel areas.

FIG. 3 illustrates a plan and sectional view, each showing a related art shadow mask, respectively.

Referring to FIG. 3, in order to form the organic EL layer, the shadow mask has holes in a predetermined numbers, through which the R/G/B luminescent substances are deposited.

The aforementioned shadow mask may be formed by wet-etching, or electro-forming.

FIGS. 4A to 4C illustrate related art shadow masks fabricated by wet-etching, respectively, and FIGS. 6A and

6B illustrate related art shadow masks each fabricated by electro-forming, respectively.

[TECHNICAL TASKS TO BE ACHIEVED BY THE INVENTION]

However, the shadow mask formed by the related art method has several problems explained in the following.

First, the shadow mask formed by wet-etching disposes via holes, each of which has a sloped sidewall, as shown in FIGS. 5A and 5B, which enables the luminescent substances to be deposited without having a shadow. However, the above via holes are separated from one another with a great distance, which is not suitable for fabrication of a display panel that requires a high precision.

Second, the shadow mask formed by the electro-forming has via holes, each of which has a vertical sidewall as shown in FIGS. 7A and 7B. However, the shadow mask formed by electro-forming causes to have a shadow phenomenon depending on positions of deposition sources when a material is deposited on a display panel by using the shadow mask. Hence, the shadow phenomenon causes failure in accurate deposition of the material on a desired position of the display panel, which results in non-uniform light emission from the pixel.

Accordingly, the present invention is directed to a shadow mask that substantially obviates one or more of the problems due to limitations and disadvantages of the

related art.

An object of the present invention is to provide a shadow mask suitable for fabrication of a display that requires a high precision.

Another object of the present invention is to provide a shadow mask which has no show phenomenon but has a high reliability.

Additional advantages, objects, and features of the invention will be set forth in part in the description which follows and in part will become apparent to those having ordinary skill in the art upon examination of the following or may be learned from practice of the invention. The objectives and other advantages of the invention may be realized and attained by the structure particularly pointed out in the written description and claims hereof as well as the appended drawings.

[PREFERRED EMBODIMENTS OF THE INVENTION]

To achieve these objects and other advantages and in accordance with the purpose of the invention, as embodied and broadly described herein, a shadow mask for fabricating an organic electroluminescent (EL) device, having an organic luminescence layer formed at a crossing region of a first and second electrode lines, the shadow mask includes: a first substrate having a plurality of first apertures which are for transiting an electron beam, a second

substrate overlapped on one side of the first substrate, the side of which the electron beam is radiated, having a predetermined distance therebetween, wherein the second substrate and the first substrate are overlapped with each other in a shape of stairs.

Preferably, the second and fist substrates overlapping in the stair shape are formed to configure at least two stairs.

In the another aspect of the present invention, a method for fabricating a shadow mask used for fabrication of an organic electroluminescent (EL) device, includes the steps of: forming a first substrate having a plurality of apertures through which an electron beam is penetrated by patterning the substrate by electro-forming; and forming a second substrate in the vicinity of each of the apertures of the first substrate, keeping a predetermined distance therebetween.

Preferably, the second substrate is formed at the vicinity of both sides of respective apertures.

It is to be understood that both the foregoing description and the following detailed description of the present invention are exemplary and explanatory and are intended to provide further explanation of the invention claimed.

Reference will now be made in detail to the preferred

embodiments of the present invention, examples of which are illustrated in the accompanying drawings. FIGS. 4A and 4B illustrate a plan view and a section each showing a shadow mask in accordance with a preferred embodiment of the present invention, respectively.

FIG. 8 illustrates a plan view and a section each showing a shadow mask in accordance with a preferred embodiment of the present invention, respectively.

Referring to FIG. 8, a projected part is formed on an upper surface of the shadow mask in a shape of plurality of strips having a predetermined distance among them.

On the contrary, at a concave part of the shadow mask where the strips are not formed, there are formed apertures.

At this time, the projected part can be formed in a dot shape besides the strip or rather selected from shapes of a circle, a polygon, and stripe.

The fabrication method of the shadow mask will be described hereinafter.

First, the first substrate is patterned by electro-forming to have a plurality of apertures through which the electron beam is transited.

Thereafter, the second substrate is formed over the first substrate at the vicinity of the apertures, distanced with a predetermined height, some part of the second substrate get in contact with the first substrate.

Herein, the second substrate may have a thickness thicker than a thickness of the first substrate.

Reference numeral part 200 in the FIG. 8 will be illustrated in detail with reference to embodiments of FIGS. 9A to 11B.

Referring to FIG. 9A, the shadow mask is formed with only some part thereof is overlapped in two layers. In the meantime, the shadow mask is formed with the whole part of the substrate is overlapped, which is illustrate in FIG. 9B. The above two methods can be selectively used considering the size and shape of the apertures of the shadow mask.

Referring to FIG. 10A, the shadow mask is overlapped in two layers, having the width of 'a' part in approximately 1 to 100 μm thickness and the width of 'b' part in approximately 1 5 to 1000 μm thickness.

In another embodiment, as shown in FIG. 10B, the shadow mask is overlapped in two layers, having the distances 'd' and 'e' between the edges of the fist substrate and the second substrate about 1 to 1000 μm, respectively.

FIGS. 11A and 11B are illustrating process of depositing luminescent substances on the first electrode using the shadow mask overlapped in plural layers.

Referring to FIG. 11A, the luminescent substance is deposited on the first electrode by elelctro-forming.

The shadow masks overlapped in plural layers are moved a bit every time after the R/G/B luminescent substances are deposited on the first electrode through the shadow mask having the plurality of apertures.

The organic EL device fabricated using the above method shows a reduced a shadow phenomenon.

Hereinafter, a deposition process of an organic luminescence layer of an organic EL display device using a shadow mask structure of the present invention will be explained.

First, a first electrode (cathode) is formed on a transparent substrate patterned in a stripe shape by a chemical etching. In this instance, the first electrode is made of an indium tin oxide (ITO) or a transparent material. A supplementary electrode may be applied to reduce the resistance of the first electrode.

Metals which have relatively lower resistance than the resistance of the ITO, the first electrode, such as Cr, Al, Cu, W, Au, Ni, and Ag, can be used as the supplementary electrode.

First, organic EL layer can be formed over the first electrode by depositing in vacuum.

Additionally, a buffer layer is formed over the organic EL layer. The buffer layer may be formed of an insulating substance regardless of an organic material or

inorganic material.

The buffer layer is patterned in a prescribed shape, on which a barrier is formed in a perpendicular direction to the first electrode.

Referring to FIG. 8, the shadow mask having a plurality of overlapping structure, fabricated by electro-forming, is used to deposit R/G/B layers on the first electrode in the perpendicular direction thereto.

With using the shadow mask fabricated by electro-forming, the material can be deposited on an accurate pixel position without the shadow phenomenon.

After forming the barrier, the substance used in forming the R/G/B layers are deposed on an entire luminescence region using a blank mask at once, and then each organic luminescence layer of R, G, and B is alternately arranged in rows using the shadow mask.

Alternatively, the luminescence layer of R, G, and B may also be formed at each pixel of R, G, and B using the shadow mask, not being deposited on the entire luminescence region.

Subsequently, after removing the shadow mask, the second electrode (anode) is formed by depositing anode materials such like Mg-Ag alloy, Al or other conductive materials) using the blank shadow mask.

Finally, passivation layers (oxygen adsorption layer,

moisture adsorption layer, and moisture-proof layer) are formed on the second electrode and encapsulation is carried out.

[EFFECT OF THE INVENTION]

The present invention, employing the electro-forming, is suitable for fabrication of a full color organic EL display device that requires a high precision. The shadow mask of the present invention provides high process reliability as the shadow phenomenon is eliminated, permitting to overcome a drawback of the shadow mask formed by electro-forming.

It will be apparent to those skilled in the art that various modifications and variations can be made in the present invention without departing from the spirit or scope of the inventions.

Thus, it is intended that the present invention covers the modifications and variations of this invention provided they come within the scope of the appended claims and their equivalents.

What is claimed is:

1. A shadow mask for fabricating an organic electroluminescent (EL) device, having an organic luminescence layer formed at a crossing region of a first and second electrode lines, the shadow mask comprising:

a first substrate having a plurality of first apertures which are for transiting an electron beam; and

a second substrate overlapped on one side of the first substrate, the side of which the electron beam is radiated, having a predetermined distance therebetween;

wherein, the second substrate and the first substrate are overlapped with each other in a shape of stairs.

2. The shadow mask as claimed in claim 1, wherein the second and fist substrates overlapping in the stair shape are formed to configure at least two stairs.

3. The shadow mask as claimed in claim 1, wherein a width of the first substrate is approximately from to 1 to 100 μm and a width of the second substrate is approximately 1 5 to 1000 μm.

4. The shadow mask as claimed in claim 1, wherein a distance between the first and second substrates is

approximately from 1 to 1000 μm.

5. The shadow mask as claimed in claim 1, wherein the first and second apertures have a form selected from a circle, a polygon, and stripe.

6. A method for fabricating a shadow mask used for fabrication of an organic electroluminescent (EL) device, comprising the steps of:

forming a first substrate having a plurality of apertures through which an electron beam is penetrated by patterning the substrate by electro-forming; and

forming a second substrate in the vicinity of each of the apertures of the first substrate, keeping a predetermined distance therebetween.

7. The method as claimed in claim 6, wherein the second substrate is formed at the vicinity of both sides of respective apertures.

8. The method as claimed in claim 6, wherein the second substrate has a thickness thicker than a thickness of the first substrate.

DRAWINGS

FIG. 1

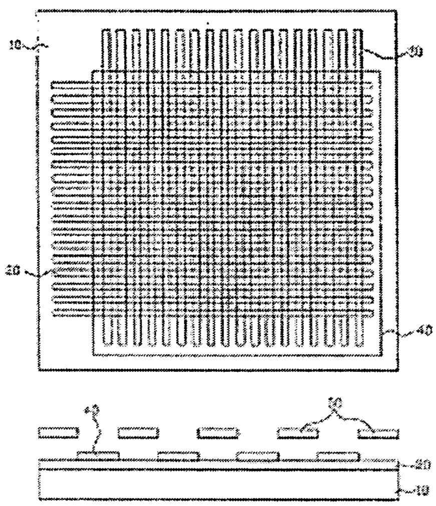

FIG. 2A

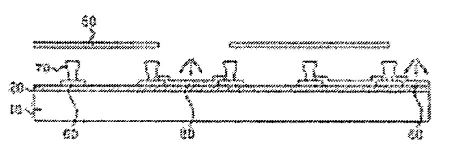

FIG. 2B

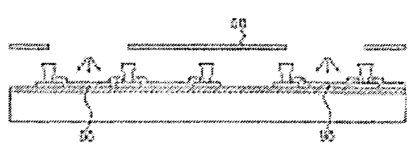

FIG. 2C

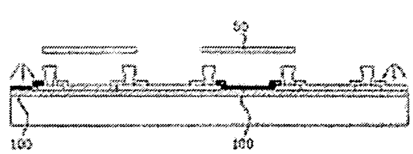

FIG. 2d

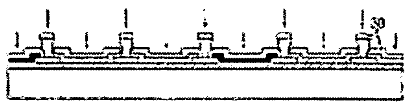

FIG. 3

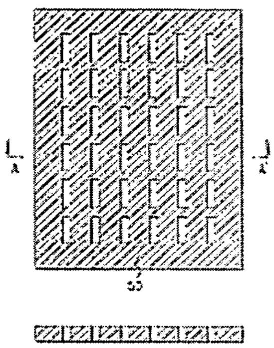

FIG. 4

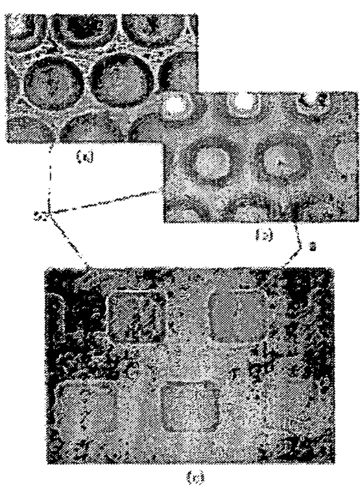

FIG. 5

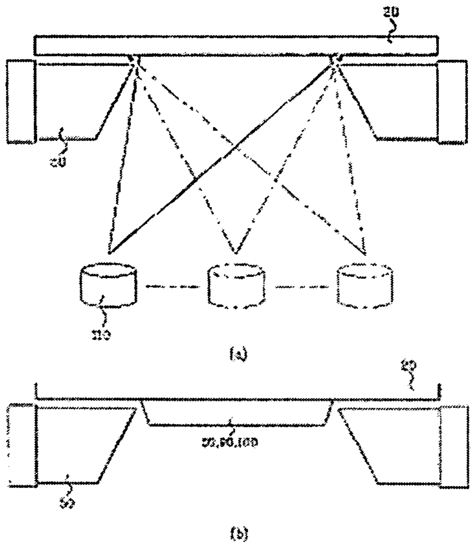

FIG. 6

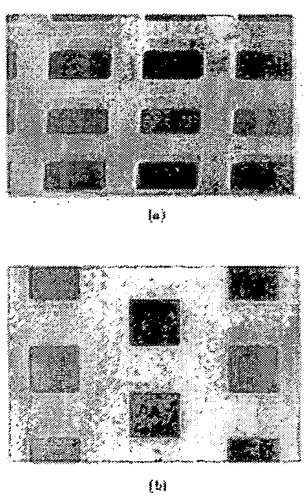

FIG. 7

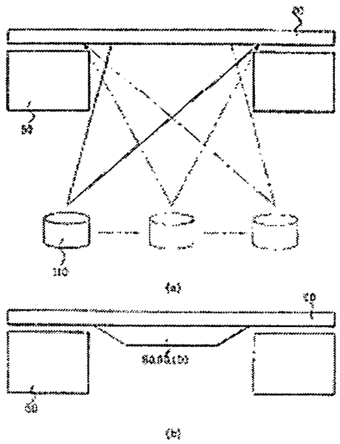

FIG. 8

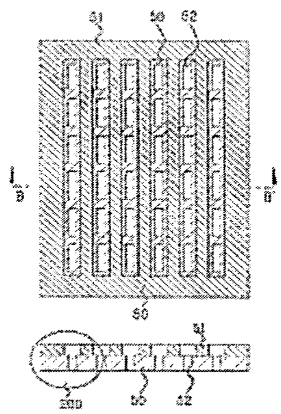

FIG. 9

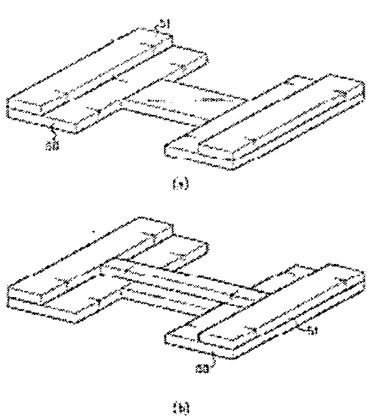

FIG. 10

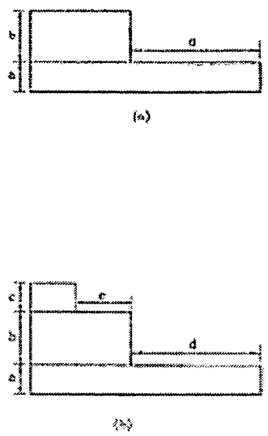

FIG.11